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Potential of Banana Peel and Peduncle Powder (Bppp) As Dietary Fiber In Chicken Patties

Muhammad Wasim Sajid* and Natasha Siddique

Department of Biosciences, COMSATS University Islamabad, Sahiwal Campus, Pakistan
*Corresponding author's e-mail: muhammad.wasim@cuisahiwal.edu.pk

Banana peel and peduncle powder (BPPP) were investigated as a sustainable dietary fiber enhancer in chicken patties. The study aimed to utilize banana fruit waste economically while enhancing the nutritional properties of chicken patties. Banana peels and peduncles were collected from a local fruit market in Sahiwal, dried, and ground into powder. Chicken patties were prepared with varying levels of BPPP (0.0%, 0.5%, 1.0%, 1.5%) and a mixture (0.5% peel + 0.5% peduncle). Chemical and sensory analyses were conducted to evaluate the impact of BPPP on the patties. Results indicated that moisture and crude fiber content remained consistent across treatments, while ash and potassium levels increased with higher BPPP concentrations. Crude protein decreased slightly with increasing BPPP. Sensory evaluation revealed that patties with 0.5% peel + 0.5% peduncle powder were comparable to the control in terms of flavor, color, tenderness, juiciness, and overall acceptability. The study concludes that BPPP can be effectively used as a dietary fiber enhancer in chicken patties without compromising sensory qualities.

Keywords: Banana waste, chicken, protein, patties, food processing, food waste utilization, nutritional enhancement.

INTRODUCTION

Musa sapientum, that is called banana, is a member of family Musaceae. Southern Asia is believed as the origin point of banana plant. The plant grows up to height of 2-8 meter and the leaves length is about 3.5m. The fruit of this plant grows in a cluster of 20 fruits to a tier. The inner fleshy matter is eaten while the outer protective covering or peel is discarded as waste (Segundo *et al.*, 2017).

Banana is one of the primitive crops, cultivated by man, that is one of the most important fruit crops. Banana (Musa species) is one of the most used up tropical fruit in the world and the world banana production in the year 2014 reached mark of 114.3 million tons. The edible part of banana represents only about one third of the total fresh banana plant weight. About l06.54 million tons of banana fruit are produced each year, that is approximately l6% of total food production in the world (Emaga *et al.*, 2007).

There are four sections of genus Musa on the basis of their chromosomes number. The name of four sections are, Australimusa, Callimusa, Eumusa and Rhodochlamys. All the members of these sub sections consist of edible cultivars (Emaga *et al.*, 2007).

Among the most extensively used fruit, banana is one of them that represents forty percent of world fruits trade. India is considered as one of the largest cultivating countries of the banana fruit (Baskar *et al.*, 2011).

Bananas belong to genus Musa of family Musaceae. The tropics of Southeast Asia is considered as the origin point of this plant. They originate from the tropical region of Southeast Asia. The Major fruit of tropics in Nigeria is Banana. The banana plant is characterized by false stem known as pseudostem, crown of large leaves presents at terminal point, and clusters of elongated and edible fruits which have yellow or rosy skin color after ripening. Principally, bananas are developed for their organic products however they likewise give different culinary, business, and biological qualities (Sundaram *et al.*, 2011). They are likewise developed to a lesser degree for the generation of fiber and as decorative plants. The natural product can be eaten crude, dried, or cooked. The taste and its surface as well as availability of this fruit throughout the year, make it popular among people of all age. Bananas are full of Vitamin B6, fiber, and contain moderate measures of Vitamin C, manganese (Mn) and potassium (K). It was set up from investigation that when bananas are devoured close by with different products of the soil, they help in decreasing the

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danger of malignant growth and different infections (Anhwange *et al.*, 2007). Banana fruit is widely consumed fruit all over the world. Banana crop leftover waste estimated was 220 tons, produced per each hectare. This waste mainly consists of lignocellulosic compounds (Emaga *et al.*, 2007). The purpose of this study is to use the BPPP in bakery product like in chicken patties to enhance the dietary contents of this product and to improve the dietary values of chicken patties while preserving its physical and sensory characteristics, to utilize the banana waste, in an economical way. This research addresses the dual challenges of food waste management and nutritional enhancement, offering a sustainable solution for the food industry.

MATERIALS AND METHODS

***Procurement of raw materials*:** Banana peduncle and peel was taken from local fruit market of Sahiwal district. Sampling was done randomly from local fruit market. Commercial flour (maida), sugar, oil, and other ingredients were obtained from local market of Sahiwal.

***Sample preparation*:** Weight percentage of fresh samples was calculated. Method (44-l5) of AACC was used to determine the moisture contents of banana peel and peduncle.

***Chemical analysis*:** The banana peel and peduncle powder was inspected for moisture, ash, crude fat, crude fiber and protein content according to methods described in AOAC (2000).

***Moisture content*:** In a dried, pre-weight Petri dish, 20-gram sample was taken. Then the sample was placed into a hot air oven for 24h at l05 ºC.

Moisture (%) = Wt. of original sample − Wt. of dried sample / Wt. of original sample x l00

***Ash*:** A Muffle furnace was used to convert oven dried sample into grayish white ash (AOAC, 923.03.) The sample was incinerated for 6 hours at 550ºC. Then the ash was cooled down and weight was noted. Following expression was used to calculate ash percentage:

Ash (%) = (Ash weight /Sample weight) ×l00

***Crude protein*:** 2-gram oven dried sample was taken. This sample was digested in a Kjeldhal's digestion flask. Nitrogen (%) = (Amount of 0.l N H2SO4 used ×0.00l4 ×250 Wt. Of sample) ×l00

Crude Protein (%) = Nitrogen % ×5.7

***Crude fat*:** Soxhlet apparatus was used to estimate crude fat. 2-gram sample (oven dried) was taken in extraction thimble and then covered with cotton plug. The following expression was used to calculate crude fat percentage.

Crude fat (%) = (Wt. of ether extract / Wt. of sample) ×100

***Crude fiber*:** Method number (AOAC, 923.03.) was used to determine crude fiber. To calculate crude fiber following expression was used:

Crude Fiber (%) = (Wl – W2 / weight of sample) × 100

***Mineral analysis*:** Mineral analysis was done by following method.

***Preparation of sample*:** In a conical flask, sample was taken. Wet digestion method was used for this process. In this procedure first digestion was done with HNO_3 (l0ml) at 70ºC for twenty minutes. After that it was digested with $HClO_4$ (5ml) at l90ºC for 20 minutes until the solution become clear and volume of solution reduced to one milliliter. Then this sample was taken into volumetric flask (l00ml), distilled water was used to made up volume, then filtered. Digested samples then were stored for mineral determinations.

***Estimation of mineral contents*:** Atomic absorption spectrophotometer was used for this purpose. Filtered sample solution was loaded in spectrophotometer for the estimation of certain mineral contents. The mineral contents of the samples were estimated by using the respective standard curve as described in (AOAC, 923.03.).

***Preparation of chicken patties*:** All-purpose flour (maida), sugar, oil, and other ingredients were obtained from the local market of Sahiwal.

***Preparation of chicken patties with different levels of BPPP*:** For the preparation of chicken patties, basic formulation was used along with some modification (Sundaram *et al.*, 2011).

***Sensory Evaluation of chicken patties*:** Cooked samples were prepared for sensory evaluation. Sensory evaluation was conducted using a 9-point hedonic scale. Panelists (n=30) assessed the patties for color, flavor, tenderness, juiciness, taste, and overall acceptability. About l5 g of cooked samples from the different treatments was randomly arranged in a pre-

Table 1. Formulation of chicken patties with different level of BPPP.

Treatment	Meat	Vegetable oil	Salt	STP	Spices	Sodium nitrate	Condiments Paste	Onion	Banana peel powder	Banana peduncle powder
T0	78.l	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.0	0.0
Tl	77.6	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.5	0.0
T2	77.l	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	l.0	0.0
T3	76.6	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	l.5	0.0
T4	77.6	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.0	0.5
T5	77.l	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.0	l.0
T6	76.6	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.0	l.5
T7	77.l	5.0	2.4	0.5	2.5	l55ppm	3.4	8.0	0.5	0.5

coded tray, the students and staff members of Comsats University of Sahiwal campus were scored flavor, color, taste, tenderness and juiciness using a 9-point qualitative scale.

***Chemical analysis of chicken patties*:** The proximate compositions of the products were determined following the (AOAC, l990) procedure.

***Statistical analysis*:** The data were interpreted by Completely Randomized Design (CRD) using Statistix software package test. Significance was defined at p< 0.05. Each experiment was repeated at least three times (Steel, 1997).

RESULTS AND DISCUSSION

The present study was carried out to introduce banana peel and peduncle powder in chicken patties. For this purpose, research was conducted in Comsats University Sahiwal campus and lab of food analysis GCU Faisalabad. At the end, collected data was subjected to statistical analysis to estimate the level of significance. The results obtained during the course of the study are presented below:

***Chemical analysis of Banana peel and peduncle powder*:** Banana peel and peduncle powder were analyzed (dry basis) for moisture, ash, crude protein, crude fat contents and mean values have been presented in Table 2 Mineral contents of banana peel and peduncle powder was also evaluated.

***Moisture content*:** The Moisture percentage of banana peel and peduncle powder in the present study were 3.25% and 5.6%, respectively these results are corelated with Zaini et al (2020). Similar results were found by Anuar (2018) who studied the banana peel and peduncle characteristics obtained through shade and microwave drying processes.

. Mean values regarding moisture content have been shown in Table 2.

***Ash content*:** The ash contents of BPPP represents the inorganic residues remaining after the burning of organic matter. Ash content is an important parameter in the milling industry. The ash contents of banana peel and peduncle powder in the present study were ll.3l% and 9.8% respectively these results are contistent with Akram et al. (2022). Similar results are also shown in other research by Bushra and Shammari (2023) who studied the effect of banana peel over the pan bread quality. Mean values regarding ash content have been shown in Table 2.

***Protein content*:** The protein contents of banana peel and peduncle powder in the present study were ll.3l% and 9.8% respectively, similar results was shown by Mohd Dom et al. (2021) who conducted study on physicochemical properties of banana peel.

***Fat content*:** Crude fat is the term used to refer to the crude mixture of fat-soluble material present in a sample. Crude fat also known as the ether extract or the free lipid content is the traditional measure of fat in food products. The fat contents of banana peel and peduncle powder in the present study were 5.9 % l.23 % respectively, these results are corelated with Zaini et al (2020). Mean values regarding fat content have been shown in Table 2.

***Crude fiber*:** In the present study, crude fiber of banana peel and peduncle powder were 47.5 % and 53.5 % respectively.

Table 2. Chemical composition of banana peel and peduncle powder.

Powders	Moisture contents (%)	Ash contents (%)	Crude fiber (%)	Crude fat (%)	Protein contents (%)	Sodium (%)	Potassium (%)	Phosphorus (%)	Calcium (%)
Banana peel	3.25±0.0l	ll.3l±0.03	47.5±0.20	5.9±0.02	3.2l±0.0l	0.l3±0.005	3.9±0.003	0.094±0.003	0.062±0.002
Banana peduncle	5.6±0.02	9.8±0.02	53.5±0.l2	l.23±0.004	5.3±0.0l	0.l2±0.03	3.6±0.0l	0.075±0.002	0.056±0.00l

Table 3. Chemical composition of standard chicken patties with different levels of banana peel and peduncle powder compared with standard bakery patties.

Treatment	Proportion of additives (%)	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	Potassium (%)
T0	Control	63.34a±0.l6	3.29ab±0.0l	l3.92a±0.03	0.35e±0.002	20.25a±0.0l	0.34d±0.00l
Tl	0.5 *BPP	52.54cd±0.2l	3.78a±0.02	l0.25b±0.04	0.74d±0.002	l7.69b±0.05	0.57c±0.00l
T2	l.0 BPP	53.60cd±0.ll	3.80a±0.0l	9.29c±0.02	0.96c±0.003	l6.72c±0.05	0.68bc±0.002
T3	l.5 BPP	48.45c±0.l0	3.49ab±0.0l	8.5c±0.0l	l.0lc±0.003	l6.l0c±0.03	l.23a±0.004
T4	0.5 **BPdP	54.40cd±0.l6	3.42ab±0.0l	6.75d±0.03	l.35b±0.002	l7.98c±0.05	0.56c±0.00l
T5	l.0 BPdP	59.lb±0.22	3.64ab±0.0l	6.24d±0.02	l.70b±0.002	l8.l4bc±0.05	0.63bc±0.00l
T6	l.5 BPdP	58.l2b±0.20	3.89a±0.0l	4.35e±0.02	2.l5a±0.003	l8.llbc±0.05	0.97b±0.003
T7	0.5BPP+0.5BPdP	53.75cd±0.22	3.70a±0.0l	7.25cd±0.02	l.65bc±0.003	l7.72bc±0.05	0.87b±0.003

*BPP= Banana peel powder; **BPdP: Banana peduncle powder

Table 4. Sensory Evaluation of chicken patties with different levels of banana peel and peduncle powder compared with standard bakery patties.

Sensory Characteristics					
Color	**Flavor**	**enderness**	**Juiciness**	**Taste**	**erall acceptance**
6.70a±0.02	6.57a±0.0l	6.25a±0.0l	6.45a±0.0l	6.67a±0.0l	6.95a±0.0l
6.56a±0.0l	6.23a±0.0l	5.43b±0.02	5.25b±0.02	6.45a±0.02	5.l5b±0.2l
6.25a±0.0l	5.l0b±0.02	5.l7b±0.02	5.43b±0.02	5.23b±0.0l	5.32b±0.02
5.37ab±0.02	5.25b±0.0l	4.89bc±0.0l	4.25c±0.0l	5.46b±0.0l	4.85b±0.0l
6.87a±0.02	4.95bc±0.0l	4.l5c±0.0l	4.60c±0.0l	4.79bc±0.0l	4.62bc±0.0l
5.90ab±0.02	4.52c±0.02	3.7lcd±0.02	3.90cd±0.02	4.43c±0.02	3.85c±0.0l
6.00a±0.02	4.73c±0.0l	3.l5d±0.02	3.93cd±0.0l	4.25c±0.0l	2.75d±0.0l
5.63ab±0.0l	5.57ab±0.02	5.98a±0.02	5.97a±0.0l	5.86ab±0.0l	6.75a±0.02

Crude fiber is estimated in both powders and the result was summarized in Table 2

***Mineral analysis of BPPP*:** In the present study the sodium, potassium, phosphorus and calcium contents of banana peel powder were estimated to be 0.13 %, 3.9%, 0.094 %, 0.062 and for banana peduncle powder these contents were estimated to be 0.12%, 3.6 %, 0.075 and 0.056 % these results are contistent with Akram et al. (2022). Samples were analyzed for minerals and the results are shown in Table 2. Non-significant difference was found in the nutrient composition of banana peel and banana peduncle powder in terms of moisture, ash, protein and mineral contents. Significant difference was found in the fiber and fat contents of banana peel and banana peduncle powder.

***Proximate analysis of chicken patties*:** The results of proximate analysis of chicken patties i.e. moisture, ash contents, crude fat, crude fiber and protein are shown in Table 3

***Minerals analysis of chicken patties*:** The chicken patties were analyzed for potassium contents only, which was in high amount, both in banana peel and peduncle powder. Potassium level of chicken patties were estimated and in present study the potassium level of control was 0.34 %. The potassium level of chicken patties with 0.5, l.0, l.5 % of banana peel powder was 0.57%, 0.68% and l.23% respectively, while potassium level of chicken patties with added banana peduncle powder at the proportion of 0.5, l.0 and 0.56%, 0.63% and 0.97% respectively. The potassium level of patties with added banana peel and peduncle powder at the ratio 0.5%+0.5% was 0.87%. These results are corelated with Zaini et al (2020).

***Sensory evaluation*:** The sensory characteristics of patties from the different treatments are presented in Table 4. Except for color, all sensory parameters evaluated were significantly different from each other. The results of control patties and the patties with 0.5+0.5% banana peel and peduncle powder were not significantly different from each other, indicating that this treatment did not significantly affect their characteristics. Results of color score of patties from each treatment were not significantly different from each other. Flavor score of control chicken patties was 6.57, for Sl the score was 6.23 and for S7 the score was 5.57. This result shows that there is not significant difference in S0, Sl and S7. While the flavor score of patties of treatment number S4, S5 and S6 were low, indicating that there is significant difference among S0, Sl S7 and S4, S5, S6 these results are consistent with Chappalwar et al. (2021) who studies the incorporation of banana peel in to chicken patties.

The purpose of this study was to introduce banana peel and peduncle powder as source of dietary fiber in chicken patties. Banana is a primitive crop cultivated by man. Conclusively, banana peel and peduncle waste is the cheaper and largely generated mass containing high contents of dietary fiber and potassium. This waste could be utilized in an economical way by using it as food additive in bakery or other food industries. In the present study, banana peel and peduncle powder was added in different proportion in chicken patties to enhance the dietary fiber of patties, without destroying its physical and organoleptic properties. Banana peel powder was added at inclusion rate of l% of both powders (0.5%+0.5%) produces a product that has almost similar properties as that of the control.

***Conclusion*:** The study demonstrates that banana peel and peduncle powder (BPPP) can be effectively used as a dietary fiber enhancer in chicken patties. The addition of 0.5% BPP + 0.5% BPdP produced patties with similar sensory and physical properties to the control while enhancing their nutritional profile. This approach offers a sustainable solution for utilizing banana waste and improving the dietary value of meat product.

***CRediT author statement*:** Muhammad Wasim Sajid designed the research project and supervised the researcher Miss Natasha Siddique

***Conflict of interest*:** Authors have no conflict of interest.

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***SDGs addressed*:** Zero Hunger, Good Health and Well-being, Responsible Consumption and Production

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